(12) UK Patent Application (19) GB (11) 2 184 512 (13) A

(43) Application published 24 Jun 1987

(21) Application No 8629414

(22) Date of filing 9 Dec 1986

(30) Priority data

(31) 3544810 (32) 18 Dec 1985 (33) DE

(71) Applicant
Hew-Kabel Heinz Eilentropp KG,

(Incorporated in FR Germany),

Klingsiepen 12, D-5272 Wipperfürth, Federal Republic of Germany

(72) Inventors
Heinz Eilentropp,
Jean Jaques Desbordes,
Walter Steffes,
Klaus Schwamborn

(74) Agent and/or Address for Service
G.F. Redfern & Co., Marlborough Lodge, 14 Farncombe Road, Worthing, West Sussex BN11 2BT

(51) INT CL⁴
F16L 57/00 G02B 6/44 H01B 7/34

(52) Domestic classification (Edition I)
F2P 101 1A18A 1A35 1A9 1B3 1B5D 1B7F 1B7W C27
G2J G20 GCA1
H1A 1C 1D2 1G 2E2A 2E2B2 2E4B1 6S
U1S 2314 F2P G2J H1A

(56) Documents cited

GB A 2138168	GB 1211860
GB A 2128394	GB 1107550
GB 1595892	GB 0986342
GB 1525095	GB 0904638
GB 1398229	EP 0128038
GB 1335932	EP 0097482

(58) Field of search
F2P
H2C
G2J
Selected US specifications from IPC sub-class F16L

(54) Fire resistant covering

(57) A protective casing against the external action of heat and fire for a rubber tube (1) consists of a mica-comprising tape wrapping (2) directly surrounding the tube (1), a dense wrapping (6) of ceramic threads, preferably metal-coated disposed on top of this, and a netted material (7) based on glass silk in the form of a compression sleeve holding these coverings together. Preferably a heat-reflecting covering (4) e.g. aluminium coated glass silk is interposed between the wrappings (2) and (6) and a non-inflammable heat-resistant outer sheath (8) e.g. of silicone rubber is provided. The tube (1) may carry fluid or electrical or optical cables.

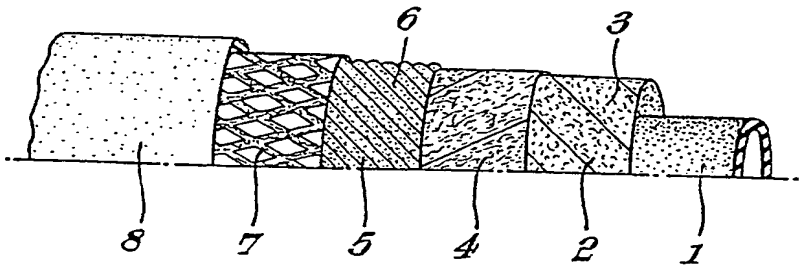

Fig. 1

GB 2 184 512 A

2184512

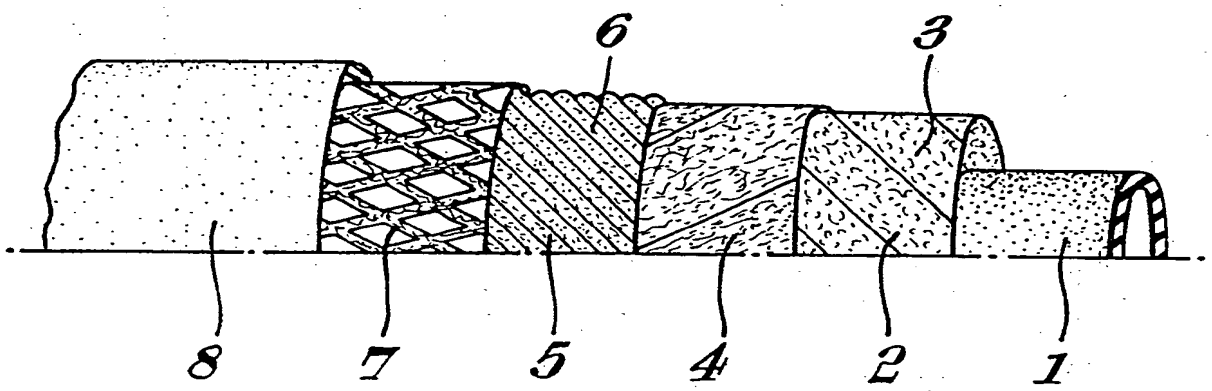

Fig. 1

2184512

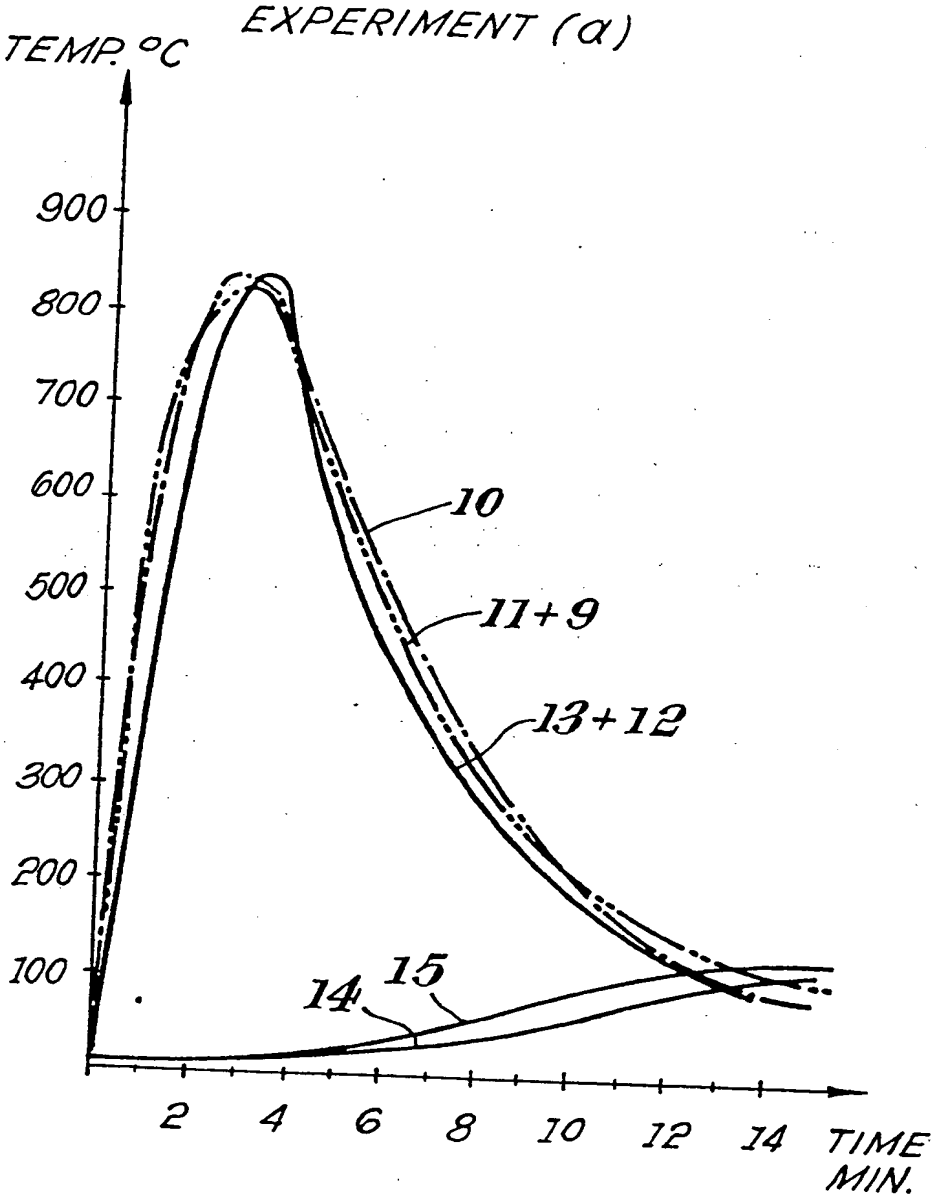

Fig. 2

2184512

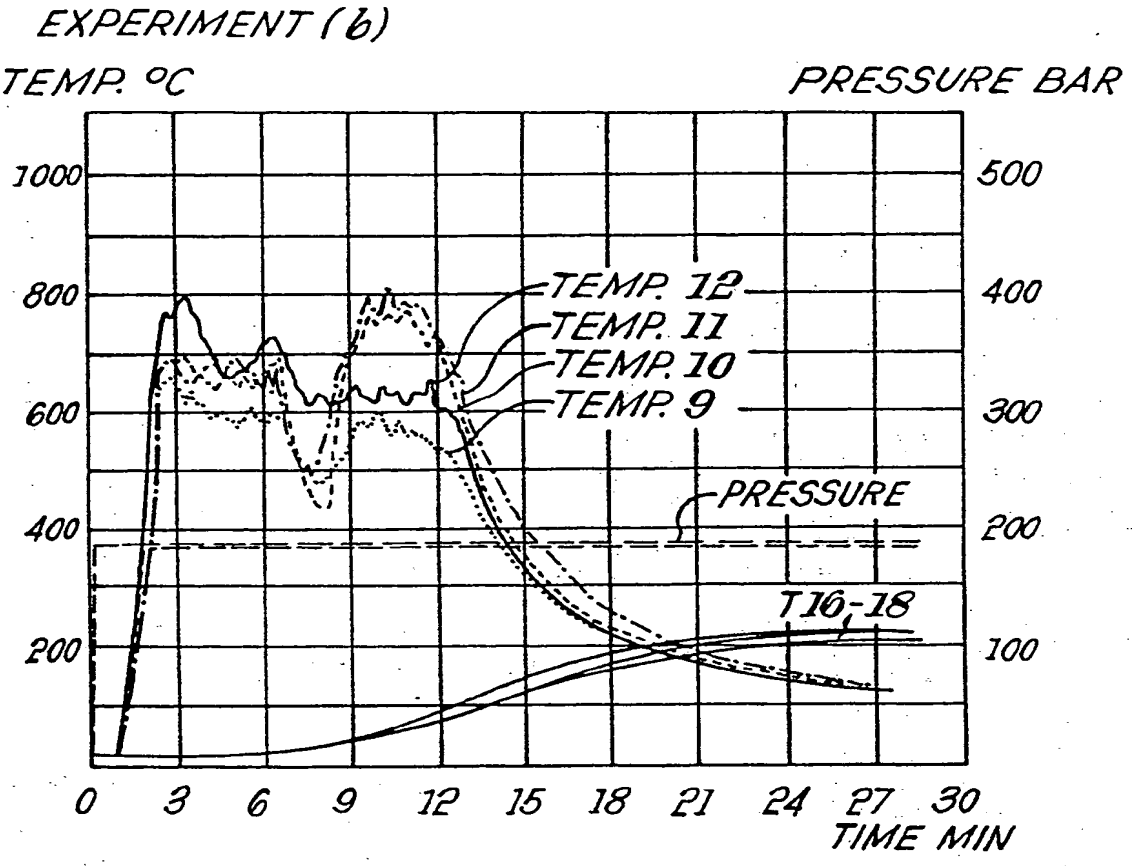

Fig. 3

SPECIFICATION

Protective casing for rope-shaped material

The present invention relates to a protective casing for rope-shaped material serving to protect the material against the action of heat and fire from outside. Examples of such rope-shaped material include media-carrying pipes, hoses or pipe-bundle cables, and electrical cables or lines, for the pneumatic, hydraulic, electrical or optical transmission of, for example, control pulses, measurements or the like.

Media-carrying pipes, hoses or pipe-bundle cables are used in the most varied engineering fields. For example, high-pressure or ultra-high-pressure hoses, (also known as hydraulic cables), are required for hydraulic actuating and driving systems; like the pipe-bundle cables, they also serve as power and information carriers in pneumatic or hydraulic measuring, control, or regulating systems. Such pressure-transmitting cables are used wherever electrical transmission is disadvantageous or not permissible on safety grounds (e.g. because of a fire risk).

In the event of a fire, or when the required hoses, pipes or pipe-bundle cables are exposed to heating producing similar effects, the aim, particularly in ship-building, but also in the chemical or petrochemical industry, is to keep the pressurized, media-carrying hoses or pipes in working order for as long as possible in order to be able to continue to use the pneumatic or hydraulic lines to carry out the measuring and regulating operations required on safety grounds after the fire has been detected, for example, in automatic installations with remote transmission.

For this purpose, it is also already known, for example, for the transmission of measurements, control pulses or the like to use pipe-bundle cables with heat-resistant metal pipes, or for pipe-bundle cables to be run in metal pipes, and for these to be provided with a suitable thermal insulation. Apart from the high cost of such arrangements and the high installation cost involved in laying them, these known designs cannot always be used because of laying requirements.

In the case of pipe designs with small, media-carrying pipes made of thermoplastic materials, it is also already known for a fire-resistant plastics mixture to be used for a sheath. However, this melts and runs at higher temperatures and, in the event of a fire, can very rapidly lay bare the medium-carrying pipe or hose and expose it directly to the action of the external heat. Thus, operation can no longer be maintained.

The development of electrical cables or lines with improved fire-resisting properties is also a priority task in electrical power or data transmission engineering. Materials for insulation and/or sheaths with flame-resisting additives have now become generally known, as also is the provision of fire-resisting or thermally-insulating layers in the structure of the cable or line. The objective is always to improve the maintenance of operation, i.e. to extend the time for which emergency operation can be maintained to trip switching operations. However, so far, neither selection of specific materials nor changes in the cable or line structure have led to significant improvements in fire-resisting characteristics, leaving aside the problems of converting a cable or line design optimised for electrical purposes to one suitable for mechanical purposes.

The underlying object of the invention is therefore to find a way of protecting such types of pipes, hoses, cables or lines made of or containing materials which are very sensitive to heat when they are exposed to relatively high temperatures, e.g. in the event of a fire, so that operation is still maintained for an adequate time. This problem is particularly evident whenever hydraulic high-pressure hoses, for example, are pressurized to pressures of, for example, 100 bar and over.

According to the invention, there is provided a protective casing for rope-shaped materials against the external action of heat and fire comprising an inner covering consisting at least predominantly of an inorganic material and applied directly to the rope-shaped material, a heat-distributing covering of high temperature-resistant material overlying said single- or multi-layer covering, and a further covering of heat-resistant and/or fire-resistant material surrounding said heat-distributing covering and acting as a compression sleeve. The casing will normally include an outer sheath of non-inflammable, heat-resistant material.

The particular advantages of such a layered structure line is the fact that the rope-shaped material, e.g. a medium or media-carrying core or a cable, are protected against the direct action of heat in that the overlying coverings and layers already ensure uniform distribution of the heat over the circumference and the length of the hose, pipe or cable, either by thermal reflection or thermal conduction. This screening zone in which the use of materials which break down at increased temperatures is deliberately avoided, undergoes additional compression or consolidation by a kind of compression sleeve. This results in the inner coverings remaining in their concentric positions around a media-carrying pipe or pipe-bundle cable, or an electrical cable even when exposed to heat, and thus acting against the medium pressure prevailing inside the hose or pipe, for example, over its entire circumference. The durability of a hose, pipe or pipe-bundle cable protected by a casing in accordance with the invention is significantly increased in spite of the high operating pressures prevailing at the temperatures encountered during a fire. The same is also true for the live cores of electrical cables, for example, which can even survive a fire when they are located within a protective casing in accordance with the invention.

One particularly advantageous embodiment of the invention is obtained when the protective casing comprises a wrapping which directly surrounds the rope-shaped material and consists at least predominantly of an inorganic material, a heat-reflecting covering over this wrapping, a

heat-distributing covering of high temperature-resistant material applied over it, at least one netting of a heat and/or fire-proof material disposed over the heat-distributing covering and acting as a compression sleeve, and an outer sealing protective sheath of a fire-resistant or fire-proof type. In the case of hydraulic hoses, for example, such a type of sheath allows operation to be maintained at temperatures in excess of 800°C and operating pressures of more than 180 bars for an adequately long period.

It has also been found to be desirable for the inorganic layer or layers directly surrounding the hose pipe, pipe-bundle cable, or electrical cable or line to be made of mica, for example, disposed on a substrate tape, in the first place to improve the flexibility of the protective casing and secondly to increase operating reliability. These tapes, which may advantageously be of different widths in the individual layers, are then wound around the rope-shaped material in the same or in different directions of winding with the mica coating advantageously facing inwardly.

The heat-reflecting covering is preferably made of a metal-coated glass silk tape. In this case, two tapes wound edge to edge could, for example, be used and, in order to obtain a closed radiation shield, it is particularly important that the metal side of the tape should face outwards, i.e. towards any possible source of heat. Alternatively, the heat-reflecting covering may be of a metal applied by vapour deposition.

The heat-distributing covering is preferably made of one or more layers of densely-wrapped heat-resistant threads or fibres. These threads or fibres, which may be made of ceramic material or contain such a material and coated with metal, form a good heat conducting and distributing layer by virtue of the metal coating and also form a kind of heat insulation in the direction of the elongate material by virtue of the insulating heat-resistant core.

All the layers or coverings referred to so far as surrounding the medium or media-carrying core are influenced by an adjoining covering of heat-resistant material, preferably made of a netted glass silk material. This covering simultaneously acts as a compression sleeve for the coverings lying beneath it, particularly in the event of a fire, when it is important that the protective casing should ensure that operation is maintained for a certain length of time.

To produce a protective casing in accordance with the invention, it is preferred to proceed by first wrapping a multi-layer bandage of mica-coated tapes around the pipe, hose, pipe-bundle cable or electrical cable or line which is itself in working order, with the mica facing inwardly, and then winding a metal-coated glass silk tape on top of the wrapping with the coating facing outwards. This layer of tape is then densely wrapped with metal-coated ceramic threads, for example, and covered first with a netted glass silk material acting as a compression sleeve, and lastly with a fire-resistant and non-inflammable outer protective sheath. The outer sheath can be made of any suitable materials, such as, for example, high temperature-resistant and flame-resistant elastomers or thermoplastic materials; such as materials based on fluoropolymers in the form of tapes, either sintered or unsintered. If extrudable materials are to be used for manufacturing reasons, preference will still be given to materials exhibiting such resistance to high temperatures. Silicone rubbers have been found to be particularly suitable in this connection, e.g. for water-proof coverings. Alternatively, the outer sheath may be in the form of a wrapping of steel tape, or may be made of an inorganic material.

Advantageously, the mica-coated tapes can have different widths from layer to layer; expediently they are wound edge to edge increasing in width towards the outside.

The invention will now be further described with reference to the drawings, in which:-

Figure 1 is a schematic side view of part of a flexible, flame-proof hydraulic pressure hose having a protective casing according to the invention, the casing being progressively cut away to illustrate its construction; and

Figures 2 and *3* are each temperature/time graphs to illustrate respectively two tests carried out on hoses as shown in Figure 1.

Referring to Figure 1, a rubber high pressure hose 1 of a known type is directly surrounded by a covering 2 made of mica or a material containing mica. Expediently mica-coated tapes 3 are used, having a glass silk substrate with the mica coating facing inwardly. The covering 2 is covered by a wrapping 4 made by winding one or more tapes of glass silk coated with aluminium; the metal coating serves as a heat shield and therefore faces outwardly. The wrapping 4 is covered with a heat-distributing covering 5 made of ceramic threads or fibres 6 wound densely around the wrapping 4.

An adjoining glass silk netting layer 7 which can also be formed by a glass silk tape, particularly with rope-shaped material of fairly large diameter, embraces the ceramic threads firmly; it also acts on the underlying coverings 2 and 4. By way of example, an outer sealing sheath 8 is made of a flame-resistant silicone rubber which is highly resistant to tearing.

Despite the presence of the multi-layer protective casing in accordance with the invention and the long endurance times thereby achieved in the event of a fire, the hydraulic hose is still adequately flexible; the hose can also be installed in a space-saving fashion. With an outside diameter of 25 mm, for example, for the inner pressure hose 1 and an 8 mm thick mica covering 2, the outside diameter of the hose protected by a casing in accordance with the invention only increases to 55 mm overall.

The following experiments were carried out on hydraulic hoses having a protective casing in accordance with the invention:

Experiment (a)

A hydraulic hose constructed as described with reference to Figure 1 was secured so as to extend

horizontally over a tray filled with oil. Five temperature sensors (numbered 9 to 13 in Figure 2) were positioned at intervals of 10 cm in a line extending cross-wise of the house in a plane parallel to the plane of the hose with one sensor 13 secured directly to the surface of the hose at the side thereof facing the tray of oil. Two further temperature sensors were respectively located within the hose 1 (sensor 14) and between the hose 1 and the covering 2 (sensor 15). The hydraulic hose was in an unpressurised state.

The oil was ignited and the maximum temperature of about 840°C was reached after about 3 minutes. The fire of the heat source (a predetermined quantity of burning hydraulic oil) went out after 15 minutes. The temperature measured by the sensor 14 within the hose 1 was about 110°C during the fire; the temperature measured by sensor 15 between the hose 1 and the covering 2 was about 120°C. The test results are shown in Figure 2.

Experiment (b)

Three hydraulic hoses constructed as described with reference to Figure 1 and provided with a protective casing in accordance with the invention, were tested simultaneously; these hoses were additionally subjected to an internal static pressure of 190 bars for the test period of 28 minutes.

The test results are shown in Figure 3. Here the curves Temp. 9 to Temp. 12 reproduce the temperatures in the vicinity of the hoses; the curves T 16 to 18 show the temperature of the pressurising medium within the three hydraulic hoses used in the test.

These tests show that the operating capacity of the medium-carrying hose beneath a protective casing in accordance with the invention is maintained without the external temperature having any significant effect. Despite the high operating pressure prevailing in the high temperature (fire) conditions, the hose remains undamaged.

The invention is not, however, limited to this case which is particularly critical owing to the simultaneous action of the high temperature produced by the fire and the internal pressure. Any pipe or any pipe-bundle cable made of metal or non-metallic material can be protected by a casing in accordance with the invention. Instead of the hose 1, any electrical or optical cable can be provided with a protective casing which makes it possible to bring the cable safely through a fire without it being damaged or maintenance of operation being jeopardized.

It is obvious that the maintenance of operation and the protection of the cable can also be influenced by a particular construction of the cable, independent of the protective casing in accordance with the invention, for example, by replacing ordinary insulating materials by insulating materials which are flame-resistant or resistant to the effects of increased temperatures.

The terms "high temperature resistant", "heat-resistant" and "fire-resistant" or "fire-proof" as used herein have their usual meaning in the art, that is that the materials so qualified do not deteriorate to any substantial degree when subjected to temperatures which are substantially above ambient temperature, and, in particular, are such as are likely to be encountered during a fire. Similarly, the term "flame-proof" has it usual meaning that a material so designated does not deteriorate appreciably when directly subjected to a flame.

CLAIMS

1. A protective casing for rope-shaped materials against the external action of heat and fire comprising an inner covering consisting at least predominantly of an inorganic material and applied directly to the rope-shaped material, a heat-distributing covering of high temperature-resistant material overlying said single- or multi-layer covering, and a further covering of heat-resistant and/or fire-resistant material surrounding said heat-distributing covering and acting as a compression sleeve.

2. A protective casing as claimed in Claim 1, comprising an inner covering consisting at least predominantly of an inorganic material, a heat-reflecting covering overlying the inner covering, a heat-distributing covering of high temperature-resistant material overlying said heat-reflecting covering, at least one covering in the form of a net made of a heat- and/or fire-resistant material overlying said heat-reflecting covering, and a non-inflammable, heat-resistant outer sheath.

3. A protection casing as claimed in Claim 1 or Claim 2, wherein said inner covering comprises a single- or multi-layer winding of a tape consisting at least predominantly of an inorganic material.

4. A protective casing as claimed in any one of Claims 1 to 3, wherein said inorganic material is mica.

5. A protective casing as claimed in Claim 4, wherein the mica is disposed on a substrate in the form of a tape.

6. A protective casing as claimed in Claim 5, wherein the mica coating always faces inwardly.

7. A protective casing as claimed in Claim 2, or any one of Claims 3 to 6 as dependent thereon, wherein said heat-reflecting covering is made of a metal-coated glass silk tape.

8. A protective casing as claimed in Claim 7, wherein the metal coating of the tape faces outwards.

9. A protective casing as claimed in Claim 7 or Claim 8, wherein the metal-coated tape is wound on.

10. A protective casing as claimed in Claim 7, wherein the heat-radiating coating is made of metal applied by vapour deposition.

11. A protective casing as claimed in any one of the preceding Claims, wherein said heat-distributing covering consists of one or more layers of densely wrapped heat-resistant threads, fibres, or strips.

12. A protective casing as claimed in Claim 11, wherein said threads, fibres or strips consist of ceramic material, or contain such a material, and are coated with metal.

13. A protective casing as claimed in any one of

the preceding Claims, wherein said further covering acting as a compression sleeve is made of a glass silk material in the form of a net.

14. A protective casing as claimed in Claim 2 or any one of Claims 3 to 13 as dependent thereon, wherein said outer sheath is made of an extruded silicone rubber.

15. A protective casing as claimed in Claim 2 or any one of Claims 3 to 13 as dependent thereon, wherein said outer sheath is made of a flame-resistant, high temperature-resistant elastomer or thermoplastic material.

16. A protective casing as claimed in Claim 2 or any one of Claims 3 to 13 as dependent thereon, wherein said outer sheath is in the form of a wrapping of steel tape.

17. A protective casing as claimed in Claim 2 or any one of Claims 3 to 13 as dependent thereon, wherein said outer sheath is made of an inorganic material.

18. A method of manufacturing a protective casing as claimed in Claim 1, wherein a multi-layer wrapping of mica-coated tape or tapes is wound around said rope-shaped material, with the mica facing inwards, a metal-coated glass silk tape is then wound on said wrapping with the coating facing outwards, this tape layer is densely wrapped with metal-coated ceramic threads and the assembly covered first with a glass silk material in the form of a net serving as a compression sleeve and lastly with an outer protective sheath.

19. A method as claimed in Claim 18, wherein said mica-coated tapes have widths which are different from layer to layer.

20. A method as claimed in Claim 19, wherein the tapes are wound edge to edge with the tape width increasing towards the outside.

21. A protective casing for a rope-shaped material substantially as hereinbefore described with reference to and as shown in Figure 1 of the drawings.

22. A rope-shaped material provided with a protective casing as claimed in any one of Claims 1 to 17 and 21.

23. A rope-shaped material as claimed in Claim 22 constituted by a pipe, hose, or pipe-bundle cable, carrying a medium or media, or an electrical cable or line, for the pneumatic, hydraulic, electrical, or optical transmission of control pulses, measurements, or the like.

Printed for Her Majesty's Stationery Office by
Croydon Printing Company (UK) Ltd, 5/87, D8991685.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.